(12) UK Patent Application (19) GB (11) 2 277 226 (13) A

(43) Date of A Publication 19.10.1994

(21) Application No 9407486.1

(22) Date of Filing 15.04.1994

(30) Priority Data
(31) 05113967 (32) 17.04.1993 (33) JP

(71) Applicant(s)
Sony Corporation

(Incorporated in Japan)

6-7-35 Kitashinagawa, Shinagawa-ku, Tokyo 141, Japan

(72) Inventor(s)
Toshihiro Shiraishi
Katsuakira Moriwake

(51) INT CL[5]
H04N 5/262 , G06F 15/62

(52) UK CL (Edition M)
H4F FD12X FD31A FD31G FD31M FD31X FESX

(56) Documents Cited
GB 2164520 A EP 0437074 A2

(58) Field of Search
UK CL (Edition M) H4F FESA FESG FESK FESX , H4T TCGG TCGK TCGX
INT CL[5] G06F 15/62 , H04N 5/262
Online databases: WPI, Inspec.

(74) Agent and/or Address for Service
D Young & Co
21 New Fetter Lane, LONDON, EC4A 1DA, United Kingdom

(54) Image transformation system for kaleidoscopic effect

(57) In an image transformation system, an image formed by an inputted video signal (S1) is stored in a memory (11) to be read out by read address produced by a predetermined read address generating means (13), so that a predetermined image transformation is performed upon the image, by merging mirror processing using orthogonal coordinates and mirror processing using polar coordinates, as a result of which a transformed image that looks as if it is seen through a kaleidoscope can be obtained.

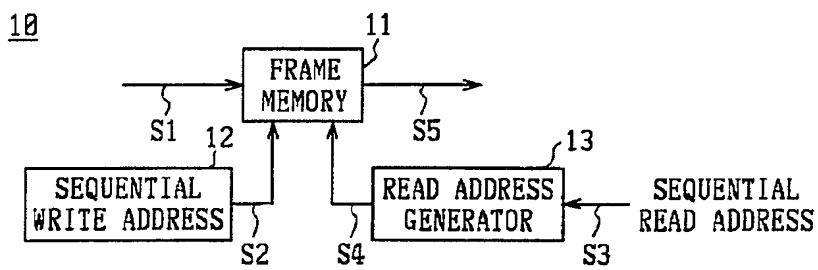


FIG. 1

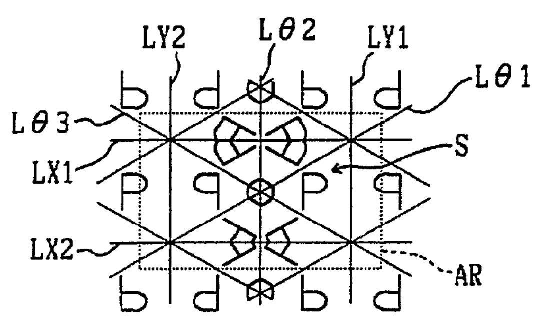


FIG. 2C

GB 2 277 226 A

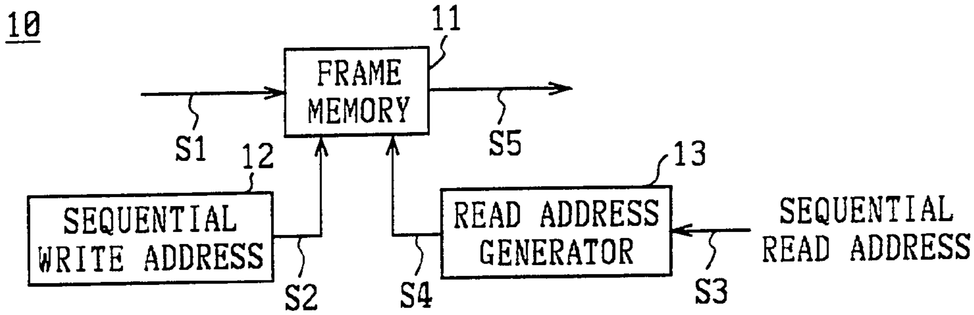


FIG. 1

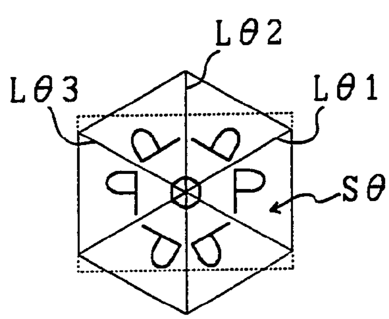


FIG. 2A

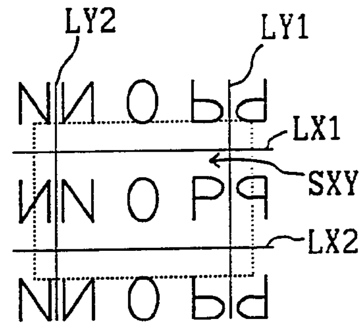


FIG. 2B

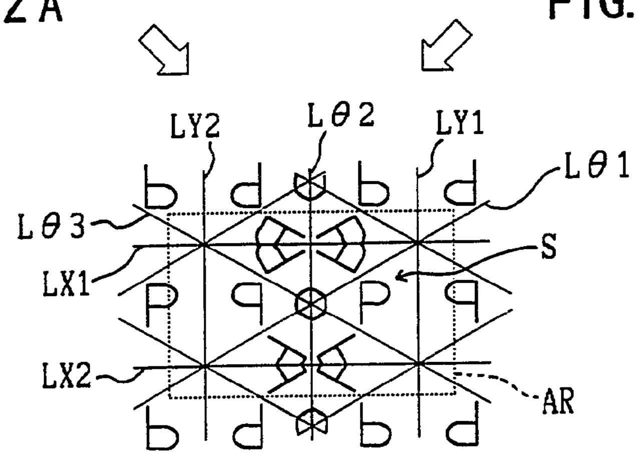


FIG. 2C

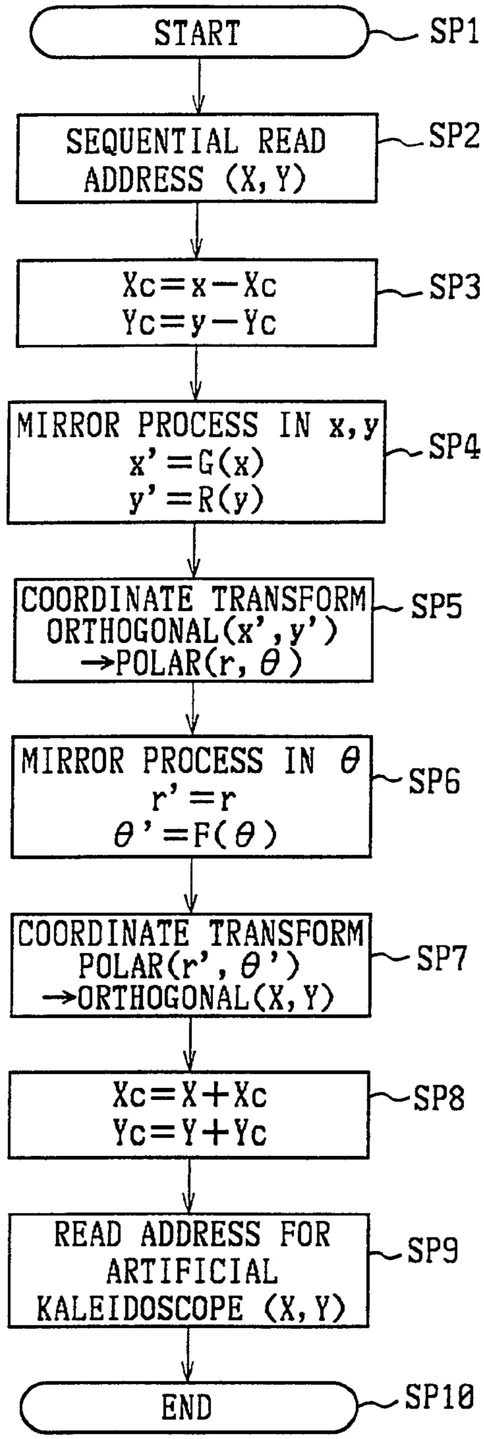
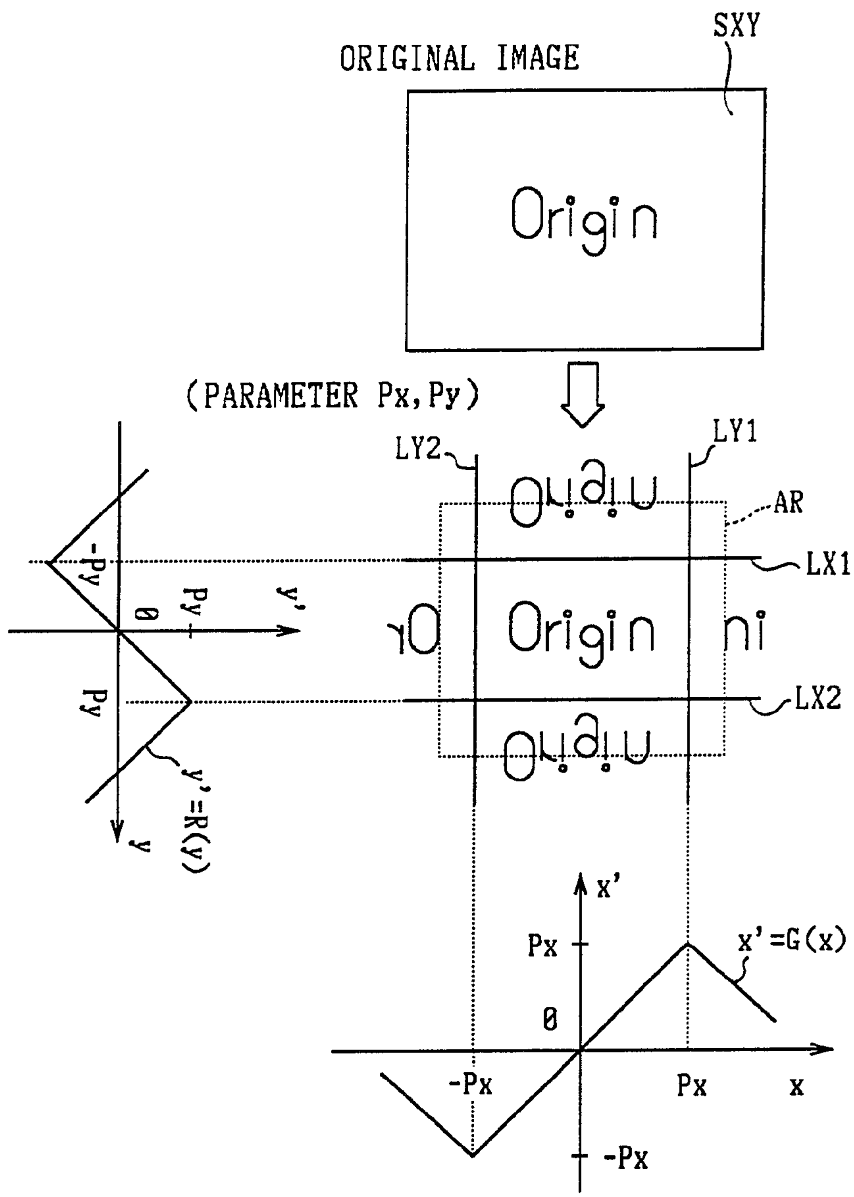
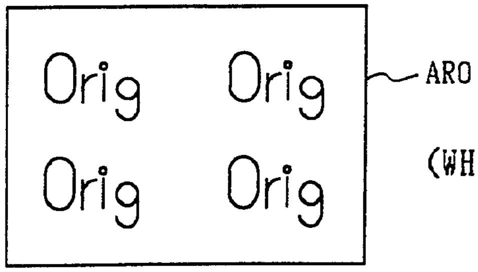

START
SP1
SEQUENTIAL READ ADDRESS (X, Y)
SP2
Xc=x−Xc
Yc=y−Yc
SP3
MIRROR PROCESS IN x, y
x'=G(x)
y'=R(y)
SP4
COORDINATE TRANSFORM ORTHOGONAL(x', y') →POLAR(r, θ)
SP5
MIRROR PROCESS IN θ
r'=r
θ'=F(θ)
SP6
COORDINATE TRANSFORM POLAR(r', θ') →ORTHOGONAL(X, Y)
SP7
Xc=X+Xc
Yc=Y+Yc
SP8
READ ADDRESS FOR ARTIFICIAL KALEIDOSCOPE (X, Y)
SP9
END
SP10

FIG. 3



ORIGINAL IMAGE
SXY
Origin
(PARAMETER Px, Py)
LY2
LY1
AR
LX1
LX2
Origin
-Py
0
Py
y'
Py
y
y'=R(y)
x'
Px
x'=G(x)
0
-Px
Px
x
-Px

FIG. 4



(WHEN PARAMETER No=4)

FIG. 5A

(WHEN PS=0) (WHEN PS= $\frac{3}{4}\pi$ [rad])

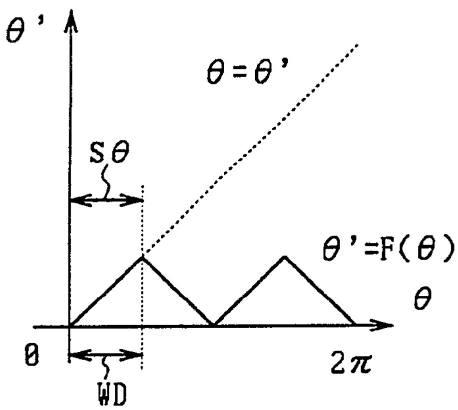


FIG. 5B

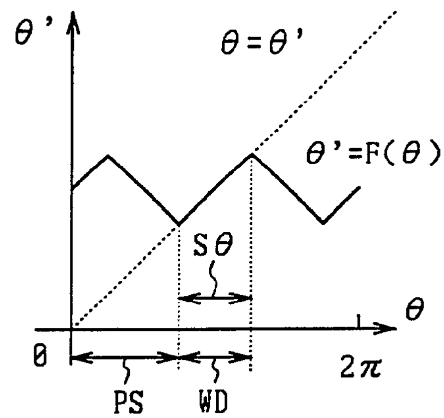


FIG. 5C

(WD=2π/No [rad])

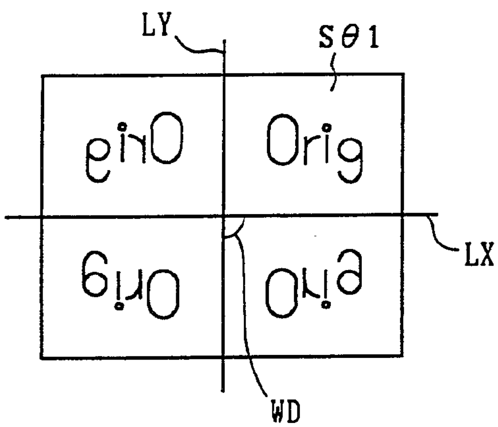


FIG. 5D

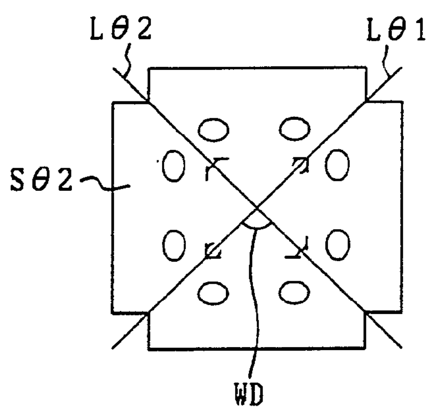


FIG. 5E

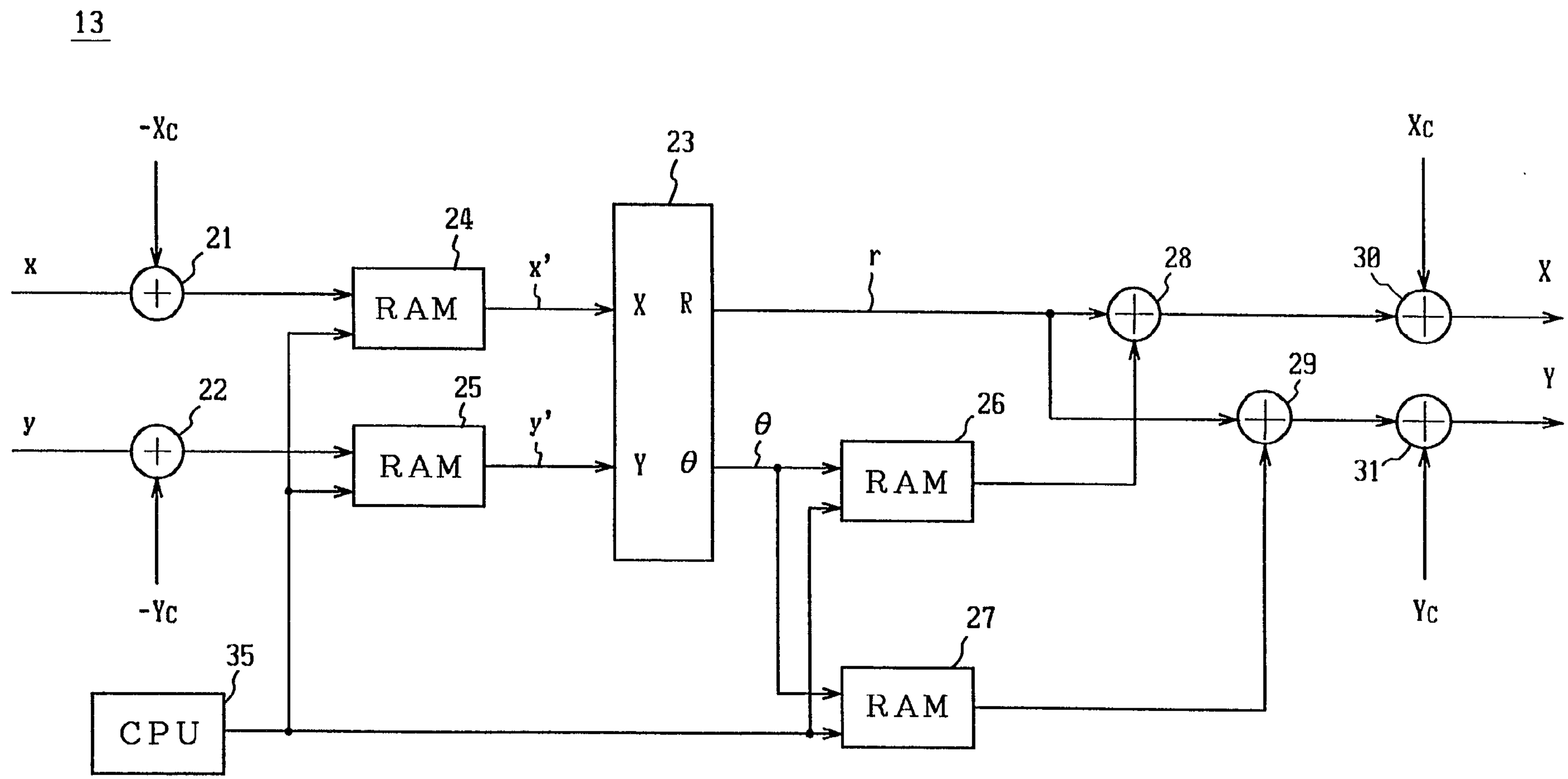

13
-Xc
x
21
24
RAM
x'
23
X
R
Y
θ
r
28
30
Xc
X
y
22
25
RAM
y'
θ
26
RAM
29
Y
31
-Yc
Yc
35
CPU
27
RAM

FIG. 6

FIG. 7A

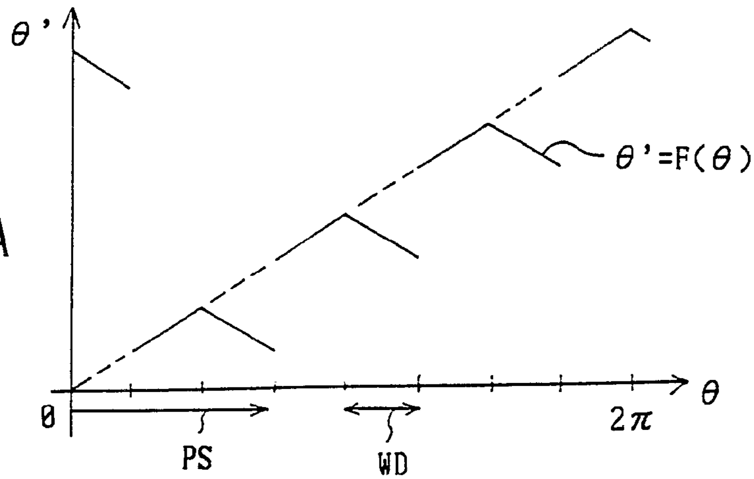
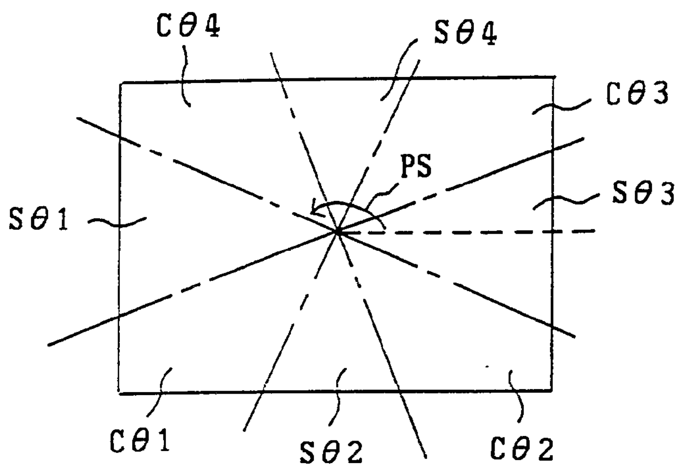


FIG. 7B



2277226

IMAGE TRANSFORMATION SYSTEMS

This invention relates to image transformation systems.

In an image transformation system disclosed, for example, in US Patent No. US-A-5 070 465, an input video signal is sequentially written in a specified area of a frame memory on the basis of a write address which is outputted from a write address generating circuit, and the data in said frame memory is read out based on a read address inputted from a read address generating circuit, whereby a variety of special effects can be inparted to the video signal to transform and display the image.

However, in this type of image transformation system which utilizes the read address control system, there has been no provision for imparting special effects like a kaleidoscope, and which performs, for example, an image transformation processing for reflecting a part of an image at every specified angle for the center of the image and for reflecting a part of an image parallel to the X-axis and the Y-axis on an X-Y plane.

According to the invention there is provided an image transformation system for performing image transformation processing on an inputted video signal, comprising:

a storing means for storing said inputted video

signal;

a first mirror processing means for reflecting a sequential read address at a predetermined reflection line in the orthogonal coordinates;

a first transformation means for transforming said read address into polar coordinates, said read address being mirror processed by said first mirror processing means, into polar coordinates;

a second mirror processing means for reflecting said read address at a predetermined reflection line, said read address being transformed into polar coordinates, at a predetermined reflection line; and

a second transformation means for transforming the output of said second mirror processing means into orthogonal coordinates, wherein, said read address transformed by said second transformation means is supplied to said storing means, thereby performing a kaleidoscope effect generating process on said inputted video signal.

A preferred form of implementation of the invention described hereinbelow provides an image transformation system for imparting a special effect to an image represented by a video signal. More particularly, the preferred system changes the input image into a transformed image resembling the input image as looked at through a kaleidoscope.

The foregoing is achieved, in the preferred form of implementation, by the provision of an image

transformation system 10 for storing an image formed by an input video signal S1 in a memory 11 and then reading out the input video signal S1 from the memory 11 based on a read address of a predetermined read address generating means 13, thus performing a predetermined image transformation to the image, the image transformation system 10 comprising: a first mirror processing means 24, 25 for reflecting the read address to be inputted to the read address generating means 13 at predetermined reflecting straight lines LX, LY in orthogonal coordinates; and a second mirror processing means 26, 27 for reflecting the read address which is mirror processed by the first mirror processing means 24, 25 and then transformed into polar coordinates, at a predetermined reflection line $L\theta$: in which the output of the second mirror processing means 26, 27 is transformed into orthogonal coordinates, and thereafter is outputted to the memory 11 as the read address.

Further, in the preferred form of implementation, the second mirror processing means 26, 27 shifts a part of the line of a function $F(\theta)$ to transform angle data θ of the polar coordinates so as to match a line "$\theta' = \theta$" having no change of the angle data θ, thereby rotatively shifting the reflection line $L\theta$ around the center "O" of effect in every predetermined angle.

Further, in the preferred form of implementation, the second mirror processing means 26, 27 shifts a

plurality of portions of the line of the function $F(\theta)$ to transform the angle data θ of the polar coordinates so as to match the line "$\theta' = \theta$" having no change of the angle data θ, thereby forming the original image portion $S\theta$ around the center "O" of effect with each interval of a predetermined angle.

Further, in the preferred form of implementation, the second mirror processing means 26, 27 offsets the center point "O" of effect for intersecting the reflection line $L\theta$ by a predetermined amount Xc, Yc.

Further, in the preferred form of implementation, the read address generating means 13 arbitrarily sets the position Px, Py where the reflection line LX, LY is arranged in the first mirror processing means 24, 25, the division number No of the reflection line $L\theta$ within one round in the second mirror processing means, and the original image portion PS to be reflected.

The invention will now be further described, by way of illustrative and non-limiting example, with reference to the accompanying drawings, in which like parts are designated by like reference numerals or characters, and in which:

Fig. 1 is a block diagram showing one embodiment of an image transformation system according to this invention;

Figs. 2A to 2C are schematic diagrams for explanation of a kaleidoscope effect generated by the

image transformation system shown in Fig. 1;

Fig. 3 is a flow chart showing a read address generating procedure for generating a kaleidoscope effect according to the image transformation system shown in Fig. 1;

Fig. 4 is a schematic diagram for the explanation of a case of reflecting orthogonal coordinates;

Figs. 5A to 5E are schematic diagrams for the explanation of a case of reflecting polar coordinates;

Fig. 6 is a block diagram showing the construction of a read address generator of the image transformation system shown in Fig. 1; and

Figs. 7A and 7B are schematic diagrams for the explanation of reflecting processing of polar coordinates according to another embodiment.

Preferred embodiments of this invention will now be described with reference to the accompanying drawings.

Referring to Fig. 1, 10 shows an image

transformation system as a whole, in which the digitalized input video signal S1 is written in a frame memory 11 without the change of the image form, based on the write address signal S2 outputted from a sequential write address counter 12.

A read address generator 13 for generating read address to read out the image data from the frame memory 11, inputs the sequential read address signal S3 to process, and then outputs the processed read address to the frame memory 11 as a read address signal S4. Then, an output video signal S5, which is read out from the frame memory 11 on the basis of the read address, forms the image in which the specified change is applied to the input video signal S1.

Figs. 2A to 2C show transformed images that has been given so-called kaleidoscope effect in the image transformation system 10. In Fig. 2A, the original image Sθ is reflected by the lines Lθ1, Lθ2, and Lθ3, which are radially positioned at every specified angle from the center point "O" of the image. Also, as shown in Fig. 2B, the original image SXY is reflected by the lines LX1, LX2, and LY1, LY2, which are respectively parallel to the X-axis and Y-axis in the X-Y plane. The mirror processing in the polar coordinates θ

direction (Fig. 2A) and the mirror processing in the orthogonal coordinates XY (Fig. 2B) are synthesized, so that, as shown in Fig. 2C, a transformed image that looks as if it were looked through a kaleidoscope can be obtained. Here, AR indicates the actual display area to be displayed.

Fig. 3 shows a kaleidoscope effect read address generating procedure in the read address generator 13. When the procedure starts from step SP1, the read address generator 13 inputs the sequential read address, which is specified in orthogonal coordinates (X, Y), by read address signal S3 at next step SP2, and then proceeds to the following step SP3.

The read address generator 13 executes the calculation of "Xc = x - Xc" and "Yc = y - Yc" at step SP3, denoting the center of effect by Xc and Yc, to obtain the center of effect from the inputted read address x, y.

Moreover, the read address generator 13 executes the mirror processing in the specified coordinates x, y in the following step SP4 by the following equations:

$$x' = G(x) \qquad \ldots (1)$$

$$y' = R(y) \quad \ldots (2)$$

Here, denoting the mirror position at "x" by "Px" and the mirror position at "y" by "Py", the function G(x) and R(y) in the mirror processing becomes, as shown in Fig. 4, a triangular wave function in which respective values change in the lines LX1, LX2 and LY1, LY2 positioned in the mirror position.

At step SP5, by executing the equations,

$$r = \sqrt{x'^2 + y'^2} \quad \ldots (3)$$

$$\theta = \tan^{-1}\left[\frac{y'}{x'}\right] \quad \ldots (4)$$

the calculated value "x'" and "y'", which correspond to the read address "x" and "y" obtained by the mirror processing in the above procedure, are transformed from the orthogonal coordinates (x', y') to the polar coordinates (r, θ), and at the following step SP6, executes the mirror processing upon the polar coordinate θ in accordance with the following equations:

$$r' = r \quad \ldots (5)$$

$$\theta' = F(\theta) \qquad \ldots (6)$$

Here, as shown in Figs. 5A to 5E, the function $F(\theta)$ in the mirror processing regarding the θ direction are specified from the number No to divide one round angle and the position PS of the original image $S\theta$ to be copied, as follows. For example, when the position PS of the original image $S\theta$ in the display image ARO is specified as "PS = 0" in the case where the position of the parameter No is No = 4 (Fig. 5A), as shown in Fig. 5B, the function $F(\theta)$ that turns over the image upon the line represented by "$\theta' = \theta$" in the range of the angle between 0° and WD (= 2π/No [rad]) in every angle WD, and the image at the angle between 0° to WD is specified as the original image $S\theta$. As a result, as shown in Fig. 5D, it is obtained a mirror effect that makes the image show as if the original image $S\theta 1$ specified among the original display image ARO has been reflected at a line LX parallel to the X-axis and a line LY parallel to the Y-axis.

On the contrary, when the position PS of the original image $S\theta$ in the display image ARO (Fig. 5A) is specified as "PS = $3/4\pi$ [rad]", as shown in Fig. 5C, the function $F(\theta)$ that turns over the image upon the

line represented by "$\theta' = \theta$" at angle between PS to WD ($= 2\pi/No$ [rad]) in every angle WD, and the image at the angle between 0° to WD is specified as the original image $S\theta$. As a result, as shown in Fig. 5E, it is obtained a mirror effect that makes the image show as if the original image $S\theta2$ specified among the original display image ARO has been reflected at the reflection line $L\theta1$ and $L\theta2$.

In this way, the polar coordinates (r', θ') calculated in the mirror processing in step SP6 in Fig. 3 is transformed into the orthogonal coordinates (X, Y) in the following step SP7 by the relational expression represented by the following equations:

$$X = r' \times \cos(\theta') \qquad \ldots (7)$$

$$Y = r' \times \sin(\theta') \qquad \ldots (8)$$

Then, the calculated orthogonal coordinates (X, Y) is outputted to the memory 11 as the read address from the read address generator 13. Therefore, the video signal is read out from the memory 11 based on the read address, and a transformation image that looks as if it is seen through a kaleidoscope, as described in Figs.

2A to 2C, can be displayed on the predetermined monitor.

Fig. 6 shows the constitution of the read address generator 13. The sequential read address "x" is added to the center position data (-Xc) of the effect at an adding circuit 21 and is input into a RAM 24.

The RAM 24 is a table which is referred by the read address, and the data of "x' = G(x)" is set by a CPU 35. Therefore, the output "x'" from the RAM 24 is inputted into a coordinate transformation circuit 23. Also, the sequential read address "y" is added to the center position data (-Yc) of the effect at an adding circuit 22 and is input into a RAM 25.

The RAM 25 is a table which is referred by the read address, and the data of "y' = R(y)" is set by the CPU 35. Therefore, the output "y'" from the RAM 25 is inputted into the coordinate transformation circuit 23.

The coordinate transformation circuit 23 transforms the read address inputted in orthogonal coordinates into polar coordinates (r, θ), and outputs the radius data "r" to an adding circuit 28. On the other hand, the coordinate transformation circuit 23 inputs the angle data θ to the RAMs 26 and 27

respectively.

The RAM 26 is a table which is referred by the polar coordinate transformed angle data θ, and the calculation data of "$\cos(\theta') = \cos(F(\theta))$" is set by the CPU 35. Also, the RAM 27 is a table which is referred by the polar coordinate transformed angle data θ, and the calculation data of "$\sin(\theta') = \sin(F(\theta))$" is set by the CPU 35.

In this way, the output of the RAM 26 is added to the radius data "r" outputted from the coordinate transformation circuit 23 at the adding circuit 28, and is thereby transformed into the orthogonal coordinate data. Further, the data is added to the center position data Xc of the effect at an adding circuit 30 so as to obtain the read address X.

On the contrary, the output of the RAM 27 is added to the radius data "r" outputted from the coordinate transformation circuit 23 at an adding circuit 29, and is thereby transformed into the orthogonal coordinate data. Further, the data is added to the center position data Yc of the effect at a adding circuit 31 so as to obtain the read address Y.

With the above constitution, by merging the mirror effect upon the orthogonal coordinates and the mirror

effect upon the polar coordinates, the transformation image that looks as if it is seen through a kaleidoscope, as described in Figs. 2A to 2C, can be obtained.

Note that the embodiments discussed above have dealt with the case where the original image Sθ is reflected at the reflection lines LX, LY or Lθ1, Lθ2 in execution of the mirror processing in the polar coordinate θ direction. However, the present invention is not limited to this but, for example, by using the function "$\theta' = F(\theta)$" as shown in Fig. 7A, the original images Sθ1 to Sθ4 can be displayed at places apart from each other as shown in Fig. 7B. Here, Cθ1 to Cθ4 is the images formed by reflecting the respective images Sθ1 to Sθ4.

Furthermore, the embodiments discussed above have dealt with the case where it is arranged that the mirror effect is obtained on a two-dimensional plane. However, the present invention is not limited to this but it can also be arranged so that the sequential read address (x, y) inputted to the read address generator 13 be one that has been transformed by a three-dimensional matrix in advance.

That is, denoting the read address transformed by

the three-dimensional matrix by x_{3D} and y_{3D}, and the three-dimensional transform matrix by α_{11} to α_{33}, the read address (x_{3D}, y_{3D}) which is represented by the equations:

$$x_{3D} = \frac{\alpha 11 \times x + \alpha 12 \times y + \alpha 13}{\alpha 31 \times x + \alpha 32 \times y + \alpha 33} \quad \cdots (9)$$

$$y_{3D} = \frac{\alpha 21 \times x + \alpha 22 \times y + \alpha 23}{\alpha 31 \times x + \alpha 32 \times y + \alpha 33} \quad \cdots (10)$$

may be inputted to the read address generator 13.

According to the arrangement described above, by merging the mirror processing upon the orthogonal coordinate and the mirror processing upon the polar coordinate, there can be realized an image transformation system, in which a transformation image that looks as if it is seen through a kaleidoscope can be obtained.

CLAIMS

1. An image transformation system for performing image transformation processing on an inputted video signal, comprising:

a storing means for storing said inputted video signal;

a first mirror processing means for reflecting a sequential read address at a predetermined reflection line in the orthogonal coordinates;

a first transformation means for transforming said read address into polar coordinates, said read address being mirror processed by said first mirror processing means, into polar coordinates;

a second mirror processing means for reflecting said read address at a predetermined reflection line, said read address being transformed into polar coordinates, at a predetermined reflection line; and

a second transformation means for transforming the output of said second mirror processing means into orthogonal coordinates, wherein, said read address transformed by said second transformation means is supplied to said storing means, thereby performing a kaleidoscope effect generating process on said inputted

video signal.

2. The image transformation system according to claim 1, wherein;

said second mirror processing means shifts the function for transforming the angle data on said polar coordinates so as to match the line "$\theta' = \theta$", thereby rotatively shifting said reflection line around the center of effect in every predetermined angle.

3. The image transformation system according to claim 1, wherein;

said second mirror processing means shifts a plurality of portions of the function for transforming the angle data on said polar coordinates so as to match the line $\theta' = \theta$, thereby forming the original image portions around the center of effect at intervals of a predetermined angle.

4. The image transformation system according to claim 1, wherein;

said second mirror processing means offsets the center point of effect said reflecting line of which intersects by the predetermined amount.

5. The image transformation system according to claim 1, wherein;

the position where the reflection line is arranged in said first mirror processing means, the division number by said reflection line within one round angle in said second mirror processing means, and the original image portion to be reflected, are set arbitrarily.

6. An image transformation system substantially as herein described with reference to the accompanying drawings.

Patents Act 1977 **Examiner's report to the Comptroller under Section 17** **(The Search report)** 18.	Application number GB 9407486.1
Relevant Technical Fields (i) UK Cl (Ed.M) H4F - FESA, FESG, FESK, FESX, H4T - TCGG, TCGK, TCGK, TCGX (ii) Int Cl (Ed.5) G06F 15/62; H04N -5/262	Search Examiner D H JONES Date of completion of Search 22 JUNE 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASES: WPI, INSPEC	Documents considered relevant following a search in respect of Claims :- 1-6

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
A	GB 2164520 A	(PHILIPS) see Figure 1 and lines 111-119 page 2	
X	EP 0437074 A2	(GRASS VALLEY) see Figure 1 and lines 26-37 column 6	1 at least

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).